United States
Department of
Agriculture

Agricultural
Research
Service

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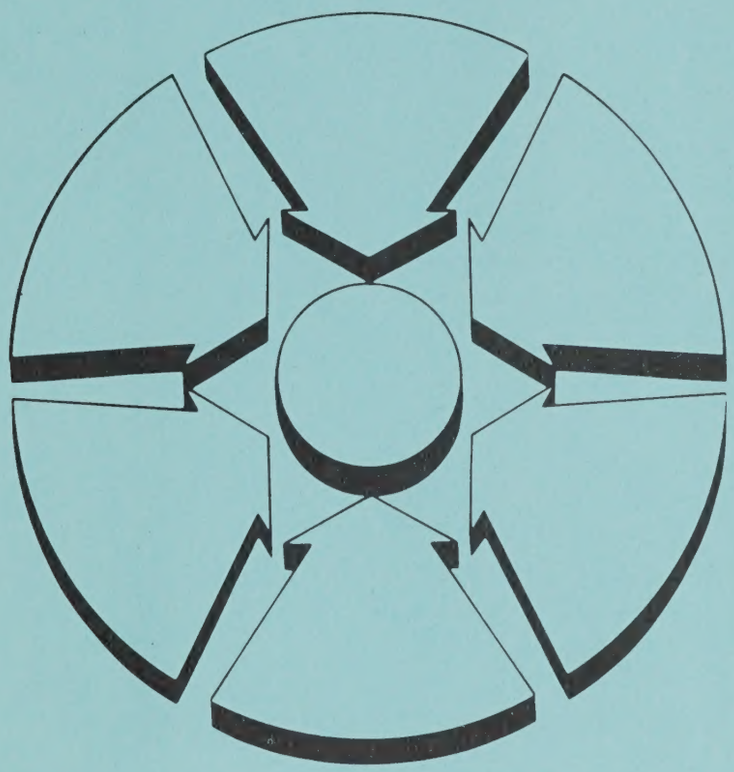
Agricultural Research Service Program Plan

6-Year Implementation Plan, 1984-1990



Contents

Introduction

In the Program Strategy of the Agricultural Research Service (ARS) Program Plan (U.S. Dept. Agr. Misc. Publ. 1429, issued 1983), ARS scientists identified the broad array of research necessary to meet the short- and long-term needs of agriculture. The research was organized into the 6 Objectives, 24 Approaches, and 98 Approach Elements (see Appendix) needed to meet the stated goal. In this 6-Year Implementation Plan, ARS presents those portions of the research described in the Program Plan that will be pursued in the planning period FY 1984-FY 1990.

The Program Plan was developed with a long-term view (20 to 50 years) and under the assumption that funds would be unlimited. In contrast, the 6-Year Implementation Plan was developed under the assumption of finite resources. The 6-Year Plan also reflects the perception, by ARS, of the short-term goals of the Administration and the Congress.

As a statement of ARS program priorities and overall research direction for the planning period, this publication will guide ARS scientists who develop research projects, along with other Agency decision makers at all organizational levels. It also will provide important information to organizations that cooperate with ARS, use ARS research findings, or provide resources for ARS activities. Plans cannot be static. The ARS must respond to expected and unexpected technological advances and research opportunities and to changes in public policy. Therefore, the 6-year plan will be reviewed and updated annually.

The section on Research Strategies, which follows, describes the broad research strategies that will influence the content and direction of the ARS program for the 6-year planning period.

The Summary on Program Emphasis and Deemphasis outlines those portions of the program, by and within objectives, that ARS intends to implement in the 6-year planning period. It specifies the program areas targeted to receive increased or decreased emphasis and projects allocations of funds to the year 1990.

The section on ARS Operational Plans describes the translation of the 6-year plan into operational plans and activities.

Research Strategies

In the Program Plan, the following three major problems were identified as challenges to the long-term ability of the United States to sustain agricultural productivity:

- o World food needs, which will certainly increase with world population over the next 40 years, will be partially met by the United States as a major supplier of agricultural commodities;
- o The decline in quantity and quality of land and water resources continues as more marginal land is put into use and as nonrenewable ground water is exhausted;
- o The annual rate of increase in agricultural productivity is showing signs of declining, and acceleration depends heavily on new technological breakthroughs.

For the period FY 1984 through FY 1990, these long-term challenges must be considered in conjunction with more immediate problems of high-production costs and loss of markets that are faced by U.S. agriculture. Not all these problems can be solved through research; some are problems associated with international trade and monetary policy. However, to the extent these problems might be solved through research, ARS, as the national agricultural research agency, must address them and perform that essential research not being accomplished by others.

Key strategies that guided development of the 6-year plan are as follows.

STRATEGY 1 THE ARS WILL MAINTAIN EMPHASIS ON MISSION-ORIENTED FUNDAMENTAL, LONG-RANGE, HIGH-RISK RESEARCH

For several decades, the generation of fundamental agricultural knowledge, the "seed corn" of technology, has not kept pace with its exploitation into useful technology. That knowledge has been used to solve relatively tractable problems at the expense of generating the new knowledge needed to solve resistant problems. Helping to fill the knowledge gap is clearly a Federal research responsibility, particularly in those rapidly advancing areas that offer potential for increasing agricultural productivity. In the judgment of ARS managers, mission-oriented, fundamental research should account for about 50 percent of the ARS program between 1984 and 1990. Historical and current data for the ARS investment in fundamental research and analysis of the changes in program emphasis projected for the 6 years indicate that the investment in fundamental research will not vary from 50 percent by more than plus or minus 10 percent.

STRATEGY 2

THE ARS WILL INCREASE EMPHASIS ON INTEGRATIVE SYSTEMS RESEARCH

In solving broad regional and national agricultural problems, ARS must consider the effects of a wide spectrum of interactive variables and constraints. To significantly increase agricultural productivity, ARS must devise ways to measure and test factors that affect the efficiency of complex management systems. The intensive farming practices required to increase future productivity require increasingly expensive inputs that will significantly increase the financial risks if crops fail. When agricultural productivity is pushed to the limits, rules of thumb and traditional criteria are inadequate bases for decisions. New management systems and models that account for interactions among components of complex agricultural systems and that accurately predict the consequences of alternative decisions are needed. The ARS is well-qualified for leading team efforts to integrate research approaches that can produce solutions to national problems. For example, producers and processors need predictive management models for making the decisions necessary for timely, appropriate responses to variations in market, weather, pests, costs, and other constraints.

STRATEGY 3

THE ARS WILL EMPHASIZE RESEARCH APPROACHES DIRECTED TOWARD INCREASING EFFICIENCY OF OPERATION AND QUALITY OF PRODUCTS, REDUCING THE USE OF NONRENEWABLE RESOURCES (SOIL, WATER, FUELS) AND INCREASING THE DOLLAR VALUE OF AGRICULTURAL PRODUCTS

Over the long term, U.S. farmers must increase their margin of profit. To that end, ARS will pursue the approaches that are directed toward efficient production, processing, and marketing of high-quality products. Efficiency should help reduce costs of all operations, increase the difference between farmers' dollars of input and of return, and improve the competetive position of U.S. products in domestic and foreign markets. The high quality of farm products should provide similar benefits. With highly efficient operations throughout the agricultural system and reasonable profits for all segments of the system, marginal lands might be withdrawn from production and nonrenewable resources conserved. Such actions should maintain the flexibility the United States might need to respond to national emergencies or shortfalls in production.

Summary of Program Emphasis and Deemphasis

Since 1966, Federal funds for agricultural research have remained about the same on a constant-dollar basis. Recognizing the probability that ARS will continue to have constant-dollar budgets in the foreseeable future, the 6-year plan identifies research program areas targeted for increased emphasis and decreased emphasis within the 1982 level of funding. Resource allocations must be shifted, over time, to achieve a program balance that will be consistent with ARS objectives.

Figure 1 gives the percentage distribution of FY 1982 ARS program funding ($413 million), by the six objectives in the Program Plan. This distribution represents the base from which shifts are planned.

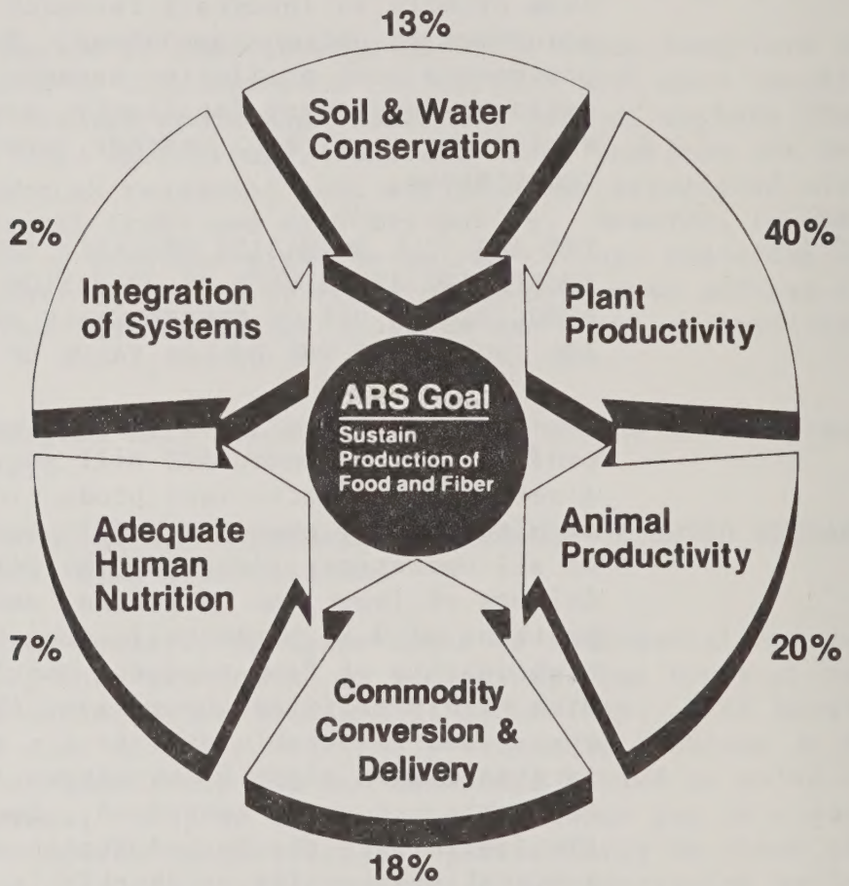


Figure 1. Distribution of funds among objectives of the ARS Program in 1982.

Before decisions were made on the reallocation of funds among objectives of the ARS program, the following factors were considered:

- Production by U.S. agriculture exceeds current domestic needs.
- The United States is facing an indefinite period of surpluses of major agricultural commodities.
- U.S. agricultural products are losing competitiveness in world markets.
- New products are needed for American farm commodities to more successfully compete in world markets.
- Lower production costs are needed for American farm products.
- The U.S. natural resource base is declining.
- Increased emphasis is needed on basic science in agriculture to replenish the dwindling store of basic knowledge.
- More ARS emphasis is needed on fundamental and applied research to increase efficiency of production.
- Integrative systems research is needed to improve the efficiency of U.S. agriculture.
- Improved human nutrition is a national priority.

On the basis of these factors, ARS will appreciably increase its emphasis on commodity conversion and delivery and human nutrition research and modestly increase its emphasis on soil and water conservation and integrative systems research. Without increased funding, ARS must carefully reallocate funds to support essential increases at the expense of some areas of research on plant and animal production. Fundamental productivity research continues to be a national priority. However, significant portions of the conventional, applied, and developmental research components of the ARS program must be assumed by other sectors of the full agricultural research system that are capable of sharing the responsibilities for carrying out that research. Within the ARS productivity research programs that will be continued, long-term fundamental studies will be emphasized to generate the basic knowledge and technology for solving major problems in the efficiency of plant and animal production. Figure 2 gives the planned percentage distribution of total ARS funding, by objectives, for the year 1990.

Figure 2. Planned distribution of funds among objectives of the ARS Program for the year 1990.

Table 1 gives the 1982 and targeted distributions of ARS funds, by both dollars and percentages. Also given are the shifts of funds planned within and across objectives to achieve the new program balance.

Table 1 indicates that a total of $75 million in the current base of the ARS program--$33 million across objectives and $42 million within objectives--is targeted for reallocation.

Details of the reallocations for achieving targeted program balance among the approaches and approach elements within each of the six objectives appear in tables 2-7 and in respective bar graphs, figures 3-8. In the tables, only the net shifts of funds from or into an approach element are indicated. Anticipated redirections of funds within approach elements are not indicated. In the figures the differences between the length of the open bar (present level) and the solid bar (targeted level) for each approach element represent the planned amount and direction net change. Major program areas for emphasis and deemphasis are listed after the tables and bar graphs.

TABLE 1. FUND ALLOCATION STRATEGIES (INCREASES, DECREASES) FOR ACHIEVING TARGETED PROGRAM BALANCE AMONG OBJECTIVES

Objective	Present Program Balance		Planned Program Changes ($M)			Targeted Program Balance	
	$M	%	Decreases	Increases	Net	$M	%
1 Soil & Water Cons.	52	13	3	9	+ 6	58	14
2 Plant Productivity	165	40	36	7	-29	136	33
3 Animal Productivity	82	20	11	7	- 4	78	19
4 Commodity Conver.	77	18	16	26	+10	87	21
5 Adequate Human Nutri.	27	7	3	17	+14	41	10
6 Integ. of Systems	10	2	6	9	+ 3	13	3
Total	$413	100	$75	$75	$0	$413	100

TABLE 2. OBJECTIVE 1: SOIL AND WATER CONSERVATION. FUND ALLOCATION STRATEGIES (INCREASES, DECREASES) FOR ACHIEVING TARGETED PROGRAM BALANCE AMONG APPROACHES AND APPROACH ELEMENTS

Approach Element	Present Program Balance			Planned Program Changes ($M)			Targeted Program Balance		
	$M	%Approach	%Objective	Decreases	Increases	Net	$M	%Approach	%Objective
Assessment									
1.1.1.Land	1.2	22			1.6		2.8	34	
1.1.2 Water	3.2	59					3.2	40	
1.1.3 Air	1.0	19			1.1		2.1	26	
Approach 1.1 Total	5.4	100	10	0	2.7	+2.7	8.1	100	14
Land									
1.2.1 Erosion	4.9	27			0.5		5.4	28	
1.2.2 Fertility	9.3	52			1.4		10.7	56	
1.2.3 Physical	1.3	7			0.8		2.1	11	
1.2.4 Organic	2.5	14		1.6			0.9	5	
Approach 1.2 Total	18.0	100	35	1.6	2.7	+1.1	19.1	100	33
Water									
1.3.1 Use	8.0	33		1.4			6.6	28	
1.3.2 Supply	9.3	38			0.8		10.1	44	
1.3.3 Irrigation	6.9	29		0.5			6.4	28	
Approach 1.3 Total	24.2	100	46	1.9	0.8	-1.1	23.1	100	40
Systems									
1.4.1 Agricultural	3.6	75			2.7		6.3	84	
1.4.2 Nonagricultural	0	0					0.0		
1.4.3 Environmental	1.2	25					1.2	16	
Approach 1.4 Total	4.8	100	9	0	2.7	+2.7	7.5	100	13
OBJECTIVE 1 Total	52.4		100	3.5	8.9	+5.5	57.8		100

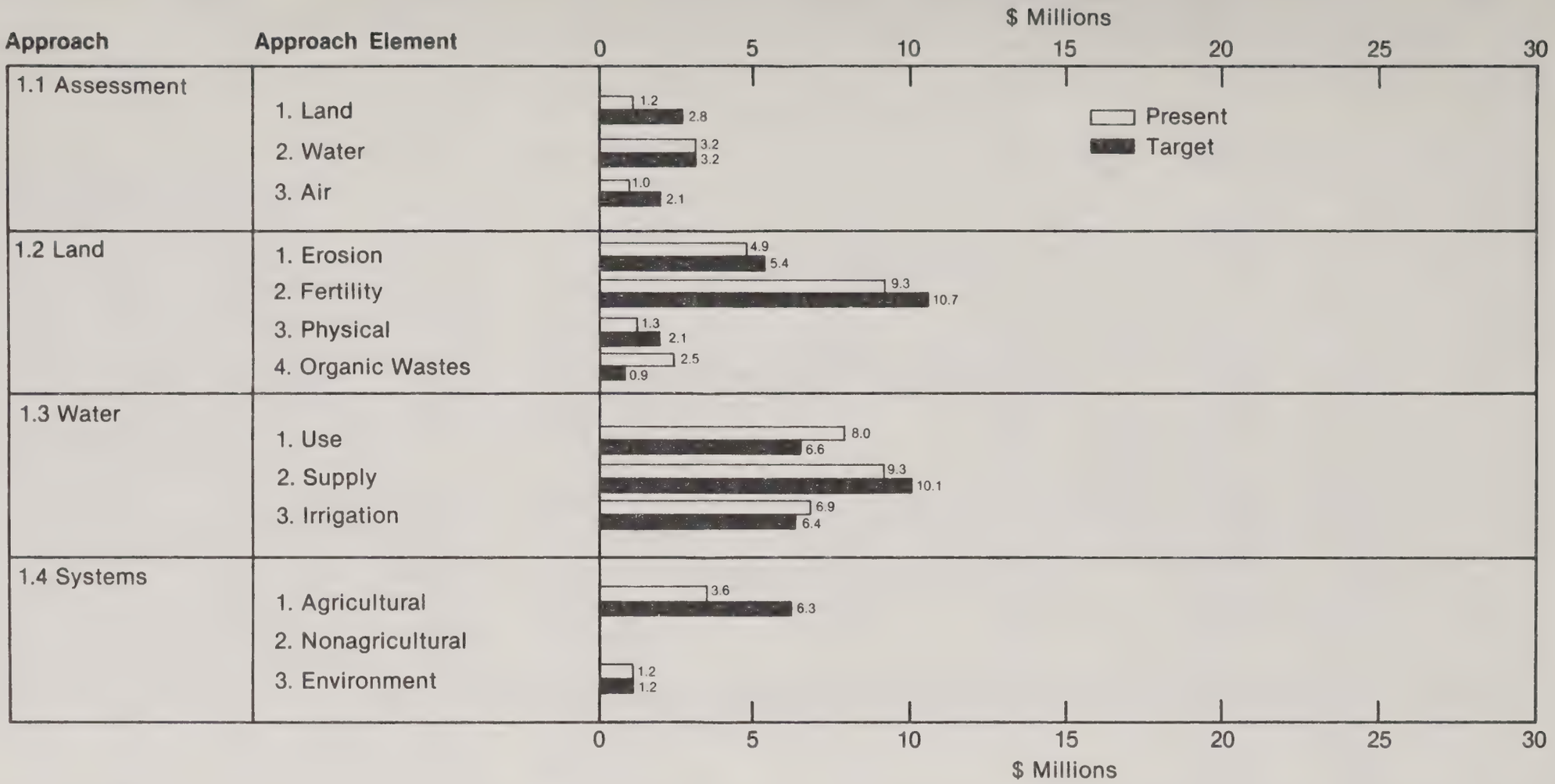


FIGURE 3.--Objective 1. Soil and Water Conservation: Present and targeted approach element allocations.

TABLE 3. OBJECTIVE 2: PLANT PRODUCTIVITY. FUND ALLOCATION STRATEGIES (INCREASES, DECREASES) FOR ACHIEVING TARGETED PROGRAM BALANCE AMONG APPROACHES AND APPROACH ELEMENTS

Approach Element	Present Program Balance			Planned Program Changes ($M)			Targeted Program Balance		
	$M	%Approach	%Objective	Decreases	Increases	Net	$M	%Approach	%Objective
Germplasm Diversity									
2.1.1. Taxonomy	4.3	26					4.3	23	
2.1.2. Acquis.-Crops	9.9	59			1.6		11.5	61	
2.1.3. Acquis.-Pests	2.5	15			0.5		3.0	16	
Approach 2.1 Total	16.7	100	10	0	2.1	+2.1	18.8	100	14
Modify Germplasm									
2.2.1. New methods	4.2	12			1.4		5.6	19	
2.2.2. Range, pasture, for.	4.0	12		0.3			3.7	13	
2.2.3. Field crops	16.5	48		4.9			11.6	40	
2.2.4. Hort. crops	9.7	28		2.0			7.7	26	
2.2.5. Benefical & pests	0.0	0			0.5		0.5	2	
Approach 2.2 Total	34.4	100	21	7.2	1.9	-5.3	29.1	100	21
Crop Productivity, Quality									
2.3.1. Basic biology	13.4	35			0.5		13.9	49	
2.3.2. Range, pasture, for.	8.3	21		2.6			5.7	20	
2.3.3. Field crops	3.7	10		2.0			1.7	6	
2.3.4. Hort. crops	3.3	9		2.0			1.3	5	
2.3.5. Pollination & honey	2.5	6		0.9			1.6	6	
2.3.6. Equip. efficiency	7.4	19		3.4			4.0	14	
Approach 2.3 Total	38.6	100	23	10.9	0.5	-10.4	28.2	100	21
Plant Protection									
2.4.1. Biology-Insects	13.5	18			0.5		14.0	24	
2.4.2. Biology-Plant path.	9.3	12			0.5		9.8	17	
2.4.3. Biology-Nematodes	1.7	2			0.5		2.2	4	
2.4.4. Ins/Dis/Nem-range,past.	1.8	3		0.5			1.3	2	
2.4.5. Ins/Dis/Nem-fld,hort.	27.1	36		12.7			14.4	25	
2.4.6. Biology-Weeds	5.9	8			0.5		6.4	10	
2.4.7. Weeds-Rng,past,for,aq.	2.2	3		0.5			1.7	3	
2.4.8. Weeds-field,hort	3.3	4		1.4			1.9	3	
2.4.9. Biol. control	4.9	7		0.7			4.2	7	
2.4.10.Agr. chem.tech.	4.7	6		2.0			2.7	5	
2.4.11.Vertebrate pests	0.6	1		0.6			-	0	
Approach 2.4 Total	75.0	100	45	18.4	2.0	-16.4	58.6	100	43
Systems									
2.5.1. Assessment	0.5	83			0.5		1.0	63	
2.5.2. Models	0.1	17			0.5		0.6	37	
Approach 2.5 Total	0.6	100	1	0	1.0	+1.0	1.6	100	1
OBJECTIVE 2 Total	165.3		100	36.5	7.5	-29.0	136.3		100

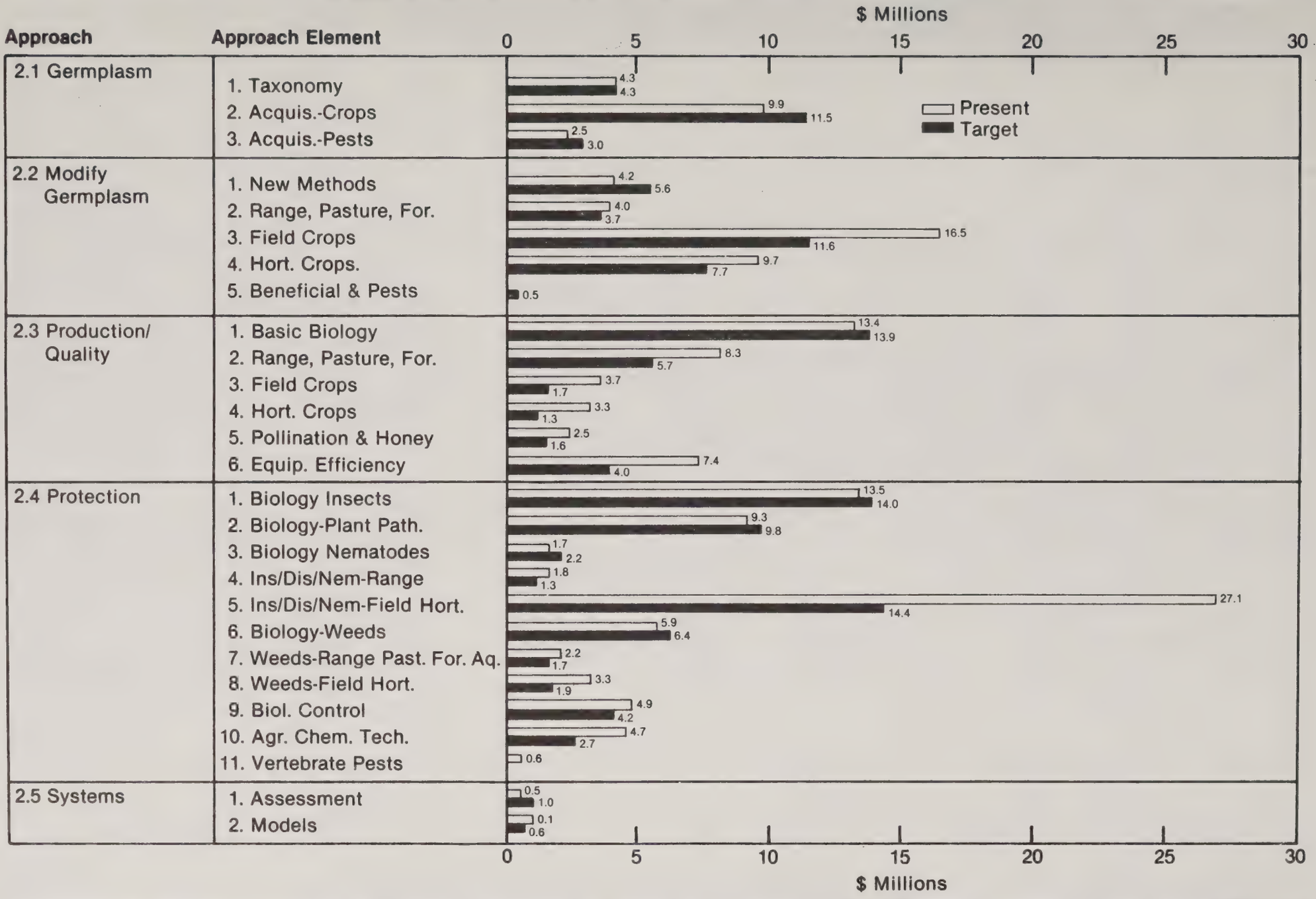


FIGURE 4.--Objective 2. Plant Productivity: Present and targeted approach element allocations.

TABLE 4. OBJECTIVE 3: ANIMAL PRODUCTIVITY. FUND ALLOCATION STRATEGIES (INCREASES, DECREASES) FOR ACHIEVING TARGETED PROGRAM BALANCE AMONG APPROACHES AND APPROACH ELEMENTS

Approach Element	Present Program Balance			Planned Program Changes ($M)			Targeted Program Balance		
	$M	%Approach	%Objective	Decreases	Increases	Net	$M	%Approach	%Objective
Genetics									
3.1.1 Selection	4.7	82		1.2			3.5	52	
3.1.2 Gene manipulation	0.4	7		0.4			0	0	
3.1.3 Biochem. genetics	0.6	11			0.5		1.1	16	
3.1.4 Disease resist.	0.0				2.2		2.2	32	
Approach 3.1 Total	5.7	100	7	1.6	2.7	+1.1	6.8	100	9
Reproduction									
3.2.1 Offspring reared	4.0	58		0.4			3.6	49	
3.2.2 Germ cell/embryos	1.2	17			1.0		2.2	30	
3.2.3 Lactations	1.7	25		0.2			1.5	21	
Approach 3.2 Total	6.9	100	8	0.6	1.0	+0.4	7.3	100	9
Nutrition									
3.3.1 Nutrient limits	3.8	36		1.2			2.6	29	
3.3.2 Nutrient losses	4.2	40		1.3			2.9	32	
3.3.3 Synthesis/comp.	2.5	24			1.0		3.5	39	
Approach 3.3 Total	10.5	100	13	2.5	1.0	-1.5	9.0	100	12
Disease									
3.4.1 Diagnosis	9.3	21		0.5		-0.5	8.8	21	
3.4.2 Stress & disease	2.4	6			0.5		2.9	7	
3.4.3 Pathogenesis	10.3	24		1.0			9.3	23	
3.4.4 Disease control	17.2	39		2.2		-2.2	15.0	37	
3.4.5 Toxicology	4.5	10			0.5		5.0	12	
Approach 3.4 Total	43.7	100	53	3.7	1.0	-2.7	41.0	100	52
Insects Ticks & Mites									
3.5.1 Detection	.8	7					0.8	7	
3.5.2 Causal mechanisms	2.1	18					2.1	19	
3.5.3 Reduced losses	5.3	47		1.6			3.7	35	
3.5.4 Integr. systems	1.9	17			1.0		2.9	27	
3.5.5 Human protection	1.3	11					1.3	12	
Approach 3.5 Total	11.4	100	14	1.6	1.0	-0.6	10.8	100	14
Systems									
3.6.1 Shelter	0.2	5		0.2			0		
3.6.2 Feed handling	0.0						0		
3.6.3 Labor efficiency	0.1	2		0.1			0		
3.6.4 Handling/transport	0.1	2		0.1			0		
3.6.5 Manure waste	0.9	24		0.9			0		
3.6.6 Stress	0.1	3			0.6		0.7	22	
3.6.7 Integr. systems	2.5	64					2.5	78	
Approach 3.6 Total	3.9	100	5	1.3	0.6	-0.7	3.2	100	4
Objective 3 Total	82.1	100	100	11.3	7.3	-4.0	78.1	100	100

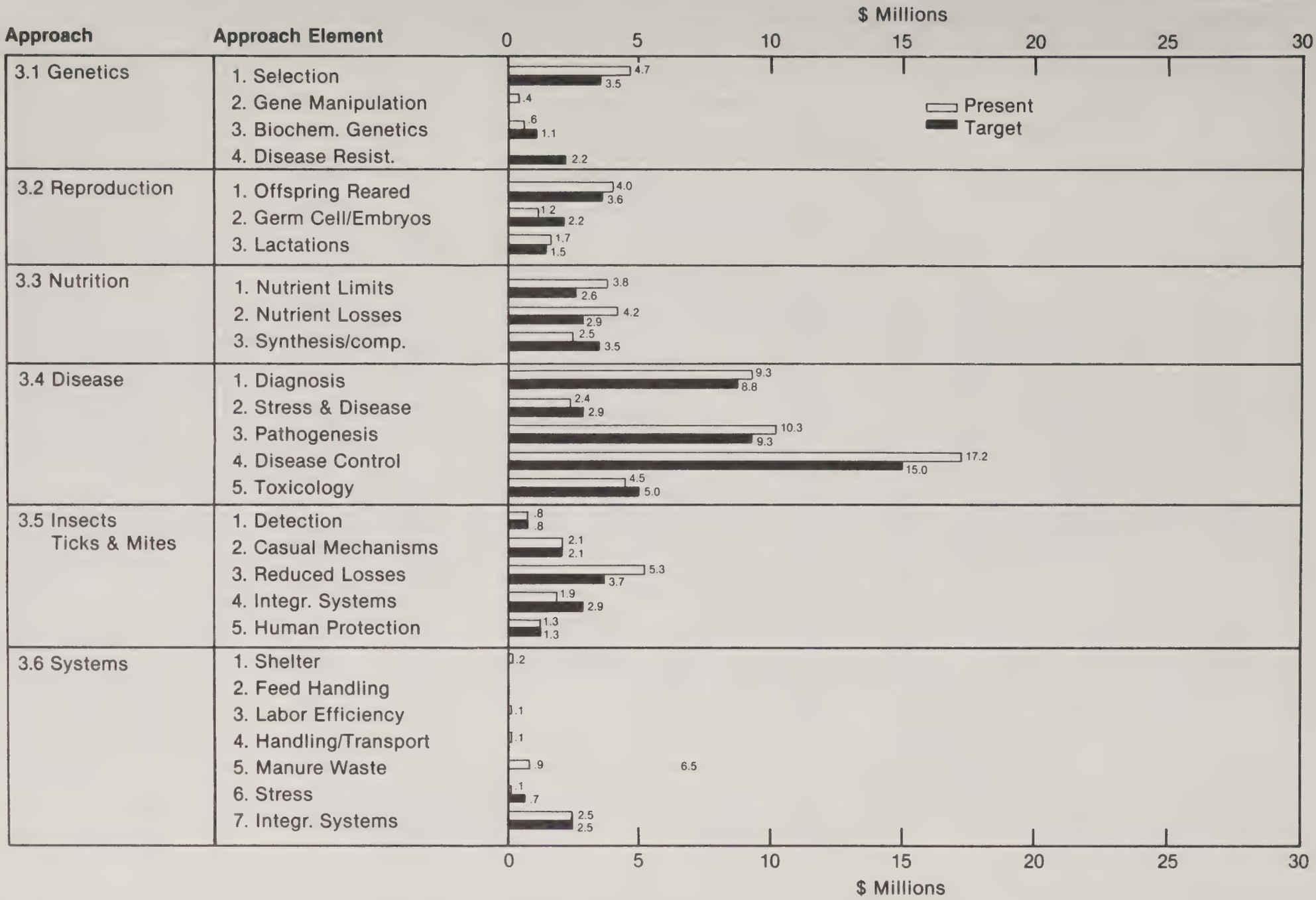


FIGURE 5.--Objective 3. Animal Productivity: Present and targeted approach element allocations.

TABLE 5. OBJECTIVE 4: COMMODITY CONVERSION AND DELIVERY. FUND ALLOCATION STRATEGIES (INCREASES, DECREASES) FOR ACHIEVING TARGETED PROGRAM BALANCE AMONG APPROACHES AND APPROACH ELEMENTS

Approach Element	Present Program Balance			Planned Program Changes ($M)			Targeted Program Balance		
	$M	%Approach	%Objective	Decreases	Increases	Net	$M	%Approach	%Objective
Quality									
4.1.1 Characteristics	13.5	38		2.5			11.0	25	
4.1.2 Mechanisms	4.0	11			10.0		14.0	33	
4.1.3 Regulation	1.5	4			5.0		6.5	15	
4.1.4 Products	17.0	47		5.5			11.5	27	
Approach 4.1 Total	36.0	100	47	8.0	15.0	+7.0	43.0	100	49
Safety									
4.2.1 Intrinsic	11.6	52		4.0			7.6	36	
4.2.2 Extrinsic	10.8	48			3.0		13.8	64	
Approach 4.2 Total	22.4	100	29	4.0	3.0	-1.0	21.4	100	25
Loss Reduction									
4.3.1 Insects	5.2	50			1.6		6.8	44	
4.3.2 Microbes	3.0	29			1.5		4.5	29	
4.3.3 Deterioration	1.6	15			2.5		4.1	27	
4.3.4 Physical	0.6	6		0.6			0		
Approach 4.3 Total	10.4	100	13	0.6	5.6	+5.0	15.4	100	18
Systems									
4.4.1 Inefficiencies	1.7	20		1.7			0		
4.4.2 Concepts	2.1	26		1.3			0.8	11	
4.4.3 Grading	2.5	31					2.5	35	
4.4.4 Exports	1.9	23			2.0		3.9	54	
Approach 4.4 Total	8.2	100	11	3.0	2.0	-1.0	7.2	100	8
Objective 4 Total	77.0		100	15.6	26.6	+10.0	87.0		100

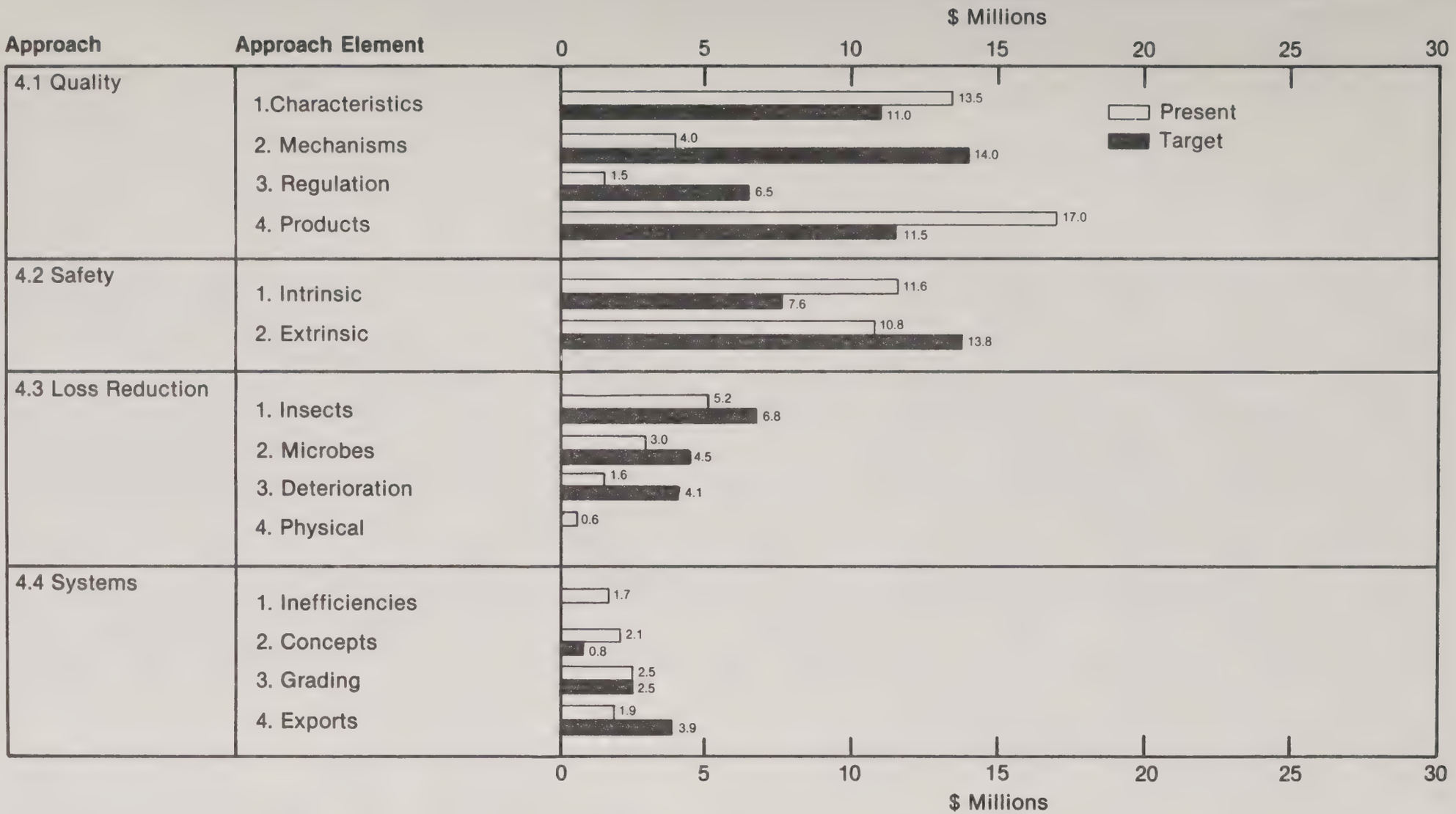


FIGURE 6.--Objective 4. Commodity Conversion and Delivery: Present and targeted approach element allocations.

TABLE 6. OBJECTIVE 5: ADEQUATE HUMAN NUTRITION. FUND ALLOCATION STRATEGIES (INCREASES, DECREASES) FOR ACHIEVING TARGETED PROGRAM BALANCE AMONG APPROACHES AND APPROACH ELEMENTS

Approach Element	Present Program Balance			Planned Program Changes ($M)			Targeted Program Balance		
	$M	%Approach	%Objective	Decreases	Increases	Net	$M	%Approach	%Objective
Nutrient Requirements									
5.1.1 Infants & child	1.2	7			2.8	+2.8	4.0	17	
5.1.2 Preg., lact. women	2.2	14			0.8	+0.8	3.0	12	
5.1.3 Adults	7.0	43		0.6		-0.6	6.4	26	
5.1.4 Aging	5.8	36			5.2	+5.2	11.0	45	
Approach 5.1 Total	16.2	100	60	.6	8.8	+8.2	24.4	100	60
Nutrient Comp. & Bioavail.									
5.2.1 Composition	4.0	47		2.0		-2.0	2.0	20	
5.2.2 Bioavailability	4.5	53			3.5	+3.5	8.0	80	
Approach 5.2 Total	8.5	100	31	2.0	3.5	+1.5	10.0	100	24
Nutr. Status Evaluation									
5.3.1 Food composition	0.2	8			0.8	+0.8	1.0	15	
5.3.2 Status methodology	1.8	75			3.2	+3.2	5.0	73	
5.3.3 Family economics	0.4	17			0.4	+0.4	0.8	12	
Approach 5.3 Total	2.4	100	9		4.4	+4.4	6.8	100	16
Objective 5 Total	27.1		100	2.6	16.7	+14.1	41.2		100

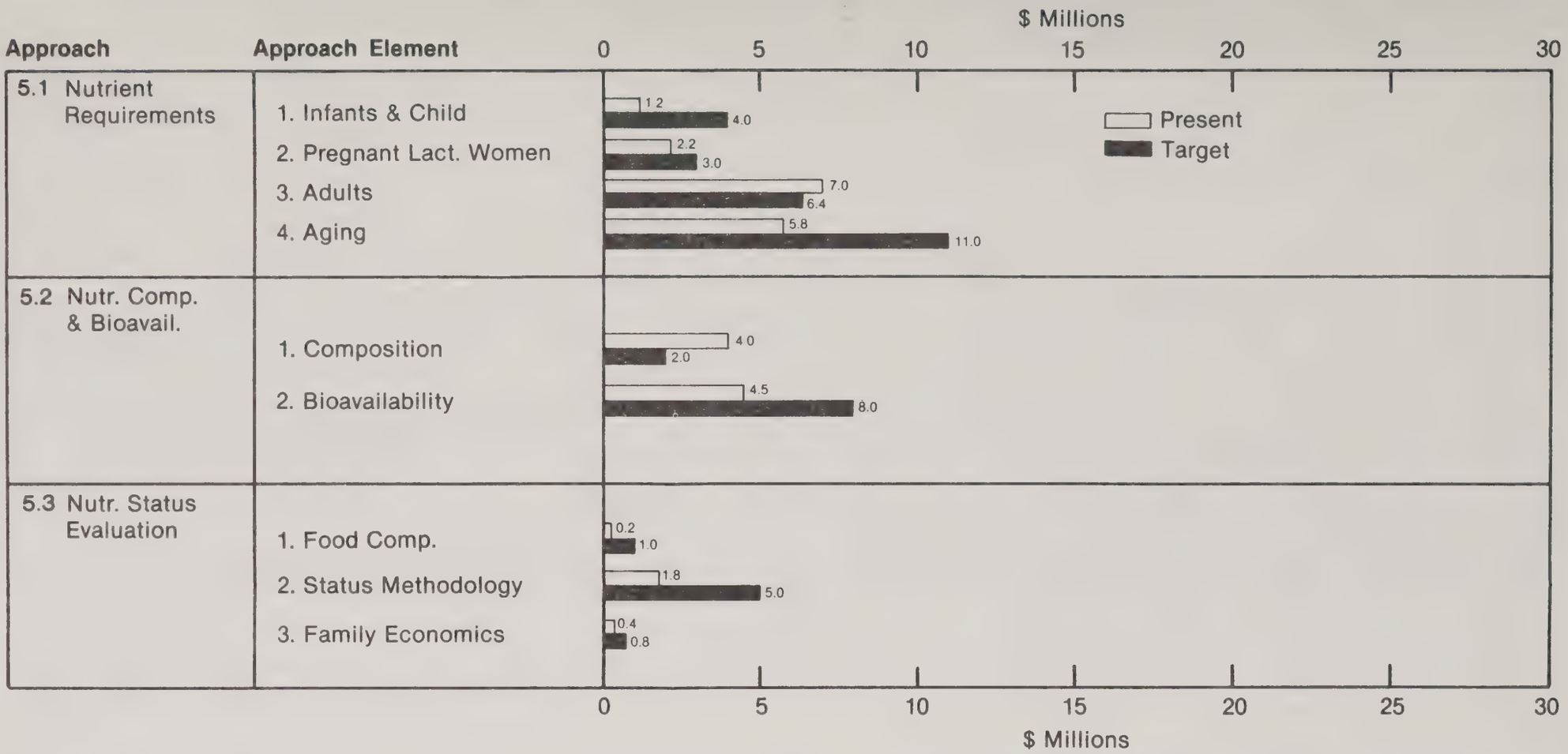


FIGURE 7.--Objective 5. Adequate Human Nutrition: Present and targeted approach element allocations.

TABLE 7. OBJECTIVE 6: INTEGRATION OF SYSTEMS. FUND ALLOCATION STRATEGIES (INCREASES, DECREASES) FOR ACHIEVING TARGETED PROGRAM BALANCE AMONG APPROACHES AND APPROACH ELEMENTS

Approach Element	Present Program Balance			Planned Program Changes ($M)			Targeted Program Balance		
	$M	%Approach	%Objective	Decreases	Increases	Net	$M	%Approach	%Objective
Integrative Systems									
6.1.1.Assessment	0	0			2.7		2.7	25	
6.1.2 Models	1.9	100			1.5		3.4	31	
6.1.3 Validation	0	0			2.8		2.8	26	
6.1.4 Remote Sensing	0	0			2.0		2.0	18	
Approach 6.1 Total	1.9	100	20	0	9.0	+9.0	10.9	100	86
Alternative Systems*									
6.2.1 Small Farms	1.1	14		0.6			0.5	29	
6.2.2 Organic	0	0		0			0	0	
6.2.3 Tropical	3.7	48		3.0			0.7	42	
6.2.4 Energy	2.9	38		2.4			0.5	29	
Approach 6.2 Total	7.7	100	80	6.0	0	-6.0	1.7	100	14
Objective 6 Total	9.6		100	6.0	9.0	+3.0	12.6		100

*Research on components of alternative systems is carried out under other Approaches.

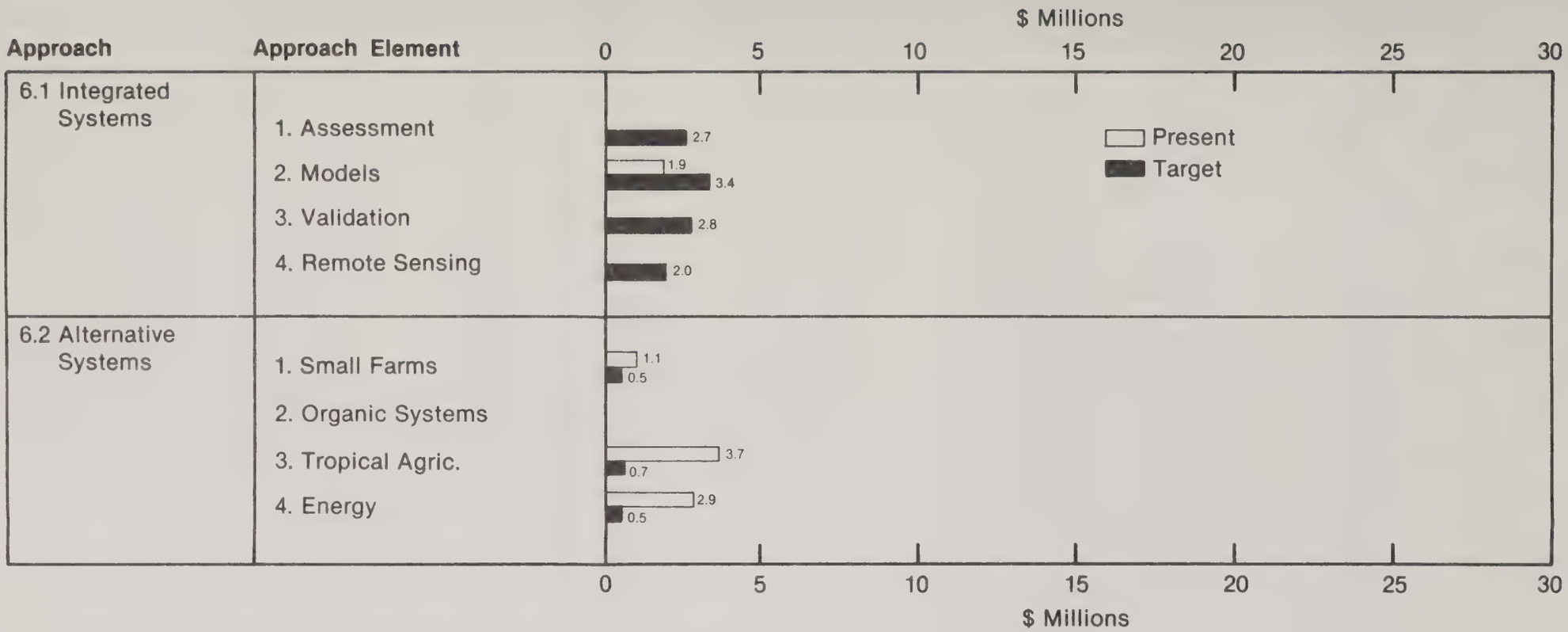


FIGURE 8.--Objective 6. Integration of Systems: Present and targeted approach element allocations.

SPECIFIC PROGRAM CHANGES

Program areas targeted for emphasis and deemphasis within each objective are listed in the outline below. The programs listed are those of major focus and do not include all changes at the approach and approach element levels.

1. Soil and Water

   A. Emphasis: Basic technology for resource assessment, base data for land/water systems analysis and predictive modeling, and programs to improve management of water resources to minimize plant stress.

   B. Deemphasis: Land shaping, engineering-structure development, field evaluation of structures, groundwater recharge, irrigation-hardware development, water-harvesting programs, and municipal and waste utilization.

2. Plant Productivity

   A. Emphasis: Acquisition and maintainence of the genetic diversity of plants, beneficial organisms, and pest species; basic studies on genetic engineering and biology of plants, beneficial organisms and pests; fundamental aspects of crop growth, yield barriers, and management methods.

   B. Deemphasis: Varietal breeding, selected small-commodity programs, location-specific cultural and management practices, pollination and honey production, applied engineering development of equipment for crop production and protection, control of pests with limited geographic or economic significance, applied research on technology for agricultural chemicals, and programs with little potential economic impact.

3. Animal Productivity

   A. Emphasis: Basic studies, at biochemical and physiological levels, on controlling genetic variation; basic research on improving genetic resistance of animals to diseases and parasites; basic studies on increasing reproductive efficiency; mechanisms of nutrient absorption and synthesis of protein and fat; genetic manipulation of pathogens for controlling and preventing disease; and integration of efficiency elements of animal production into total management systems.

B. Deemphasis: Development and field testing of killed and attenuated vaccines, applied insect-control systems, waste management, applied selection and mating programs, and nutrient-limitation work.

4. Commodity Conversion and Delivery

A. Emphasis: Basic mechanisms controlling quality characteristics of marketed products and of means for their genetic and internal control; basic studies on mycotoxin prevention and elimination; basic studies on microbial spoilage agents and pathogen-host associations for preventing contamination; new utilization approaches for exploiting biotechnological advances, adding dollar value, and expanding markets; basic studies of host-pest interactions for reducing losses; basic mechanisms of biodeterioration in harvested plant and post-slaughter animal materials; export grading; and insect and microbial barriers to export.

B. Deemphasis: Food composition, regulatory approvals and registrations, applied product and process improvement, inherent toxic-factor identification and screening, physical losses, and identification of systems inefficiencies.

5. Adequate Human Nutrition

A. Emphasis: Determination of bioavailability of food nutrients and of nutrient requirements for infants, children, and adolescents; nutrition/aging relation ships; data bases for improving evaluations of nutritional status.

B. Deemphasis: Nutrient requirement of adults and pregnant/lactating women, nutrient content of foods, dietary practices, and food-composition patterns.

6. Integration of Systems

A. Emphasis: Assimilation and integration of biological and physical research data into systems for analyzing complex interactions of two or more research areas; for example, animals, plants, and environment. Provision of bases for problem identification, and development and validation of predictive models.

B. Deemphasis: Rural housing, small-scale farming, organic farming, tropical agricultural systems, and energy.

ALTERNATIVE FUNDING STRATEGIES

If funding increases, ARS will continue to redirect funds within objectives and approaches as outlined in this 6-year implementation plan and will further increase and accelerate efforts in the high-priority program areas identified for increased emphasis. The 1990 targeted program balance (percentage distribution of funds among objectives) will be maintained with the increases.

If funding decreases, ARS will reduce programs identified for decreases in tables 1-7, while maintaining as near as possible current allocations of funding in areas of program emphasis.

ARS Operational Plans

The ARS 6-year implementation plan provides targets and directions for change in broad program areas. Programs will be adjusted incrementally through internal management and annual budget processes. In some cases, the increment of change in a given program area may be large and abrupt, either early or late in the 6-year planning period; in other cases, the changes will be gradual or in stepwise reallocations throughout the period. In yet others, the planned changes may be modified before actual achievement because the 6-year implementation plan will be updated annually as appropriate to national priorities and policies at the time and depending, partly, on the extent of program changes in the respective current or previous years.

ARS will concentrate effort in high priority program areas and develop centers of specialized research activity. ARS will pursue research for which it can provide the critical mass of resources needed to achieve the planned objectives.

On the basis of this 6-year implementation plan, ARS managers and scientists will develop operational plans that specify (1) project areas for emphasis and deemphasis; (2) timetables for action; and (3) deployment of human, physical, and capital resources for ensuring efficient progress toward the objectives of the ARS Program Plan.

Appendix: ARS Objectives, Approaches, and Approach Elements

OBJECTIVE 1 — DEVELOP THE MEANS FOR MANAGING AND CONSERVING THE NATION'S SOIL AND WATER RESOURCES FOR A STABLE AND PRODUCTIVE AGRICULTURE.

Approach 1.1 — Develop the Technology for Assessing and Predicting Long-Term Changes in the Quantity and Quality of Soil, Water, and Air Resources Available to Agriculture.

Approach Elements

- 1.1.1 — Develop improved techniques and systems for assessing, predicting, and monitoring changes in the productive capacity of land and soil resources.
- 1.1.2 — Develop improved techniques for assessing and predicting water supplies and their quality.
- 1.1.3 — Develop improved techniques for assessing and predicting the effects of weather and air quality on agricultural productivity.

Approach 1.2 — Provide the Technology Needed for Improving, Protecting, and Restoring the Productive Capacity of Agricultural Soils.

Approach Elements

- 1.2.1 — Develop cost-effective conservation technologies for controlling soil loss from croplands and rangelands.
- 1.2.2 — Devise methods for maintaining and improving soil fertility and the chemical and biological properties of soils for optimum crop production.
- 1.2.3 — Devise techniques for improving, maintaining, or restoring the physical conditions of soils that are needed for optimum crop production.
- 1.2.4 — Devise methods for safely and efficiently recycling municipal and agricultural wastes through croplands.

Approach 1.3 — Develop Improved Water-Management Systems and Practices To Achieve Effective and Efficient Use of Water Resources.

Approach Elements

- 1.3.1 — Optimize the use of water by plants in irrigated and nonirrigated croplands and rangelands to improve and stabilize productivity.
- 1.3.2 — Develop methods for increasing, conserving, and managing water supplies available for agriculture, for improving water quality, and for reducing cropland damage from flooding.

1.3.3 Improve technology for storing and distributing water supplies efficiently and for improving irrigation, drainage, and salinity-control systems and practices.

Approach 1.4 Develop Subsystems and Models That Integrate the Use of Soil, Water, and Air Resources for Optimum Management of Major Land Resource Areas.

Approach Elements

1.4.1 Develop systems and models for designing resource management strategies that optimize agricultural production and resource conservation.

1.4.2 Develop systems and models for designing resource management strategies that will satisfy the needs of nonagricultural resource uses.

1.4.3 Develop systems and models for designing resource management strategies that are compatible with environmental quality goals.

OBJECTIVE 2 DEVELOP THE MEANS FOR MAINTAINING AND INCREASING THE PRODUCTIVITY AND QUALITY OF CROP PLANTS.

Approach 2.1 Broaden the Germplasm Resources of Plants and Beneficial Organisms To Ensure Maximum Genetic Diversity for Improved Productivity.

Approach Elements

2.1.1 Develop an understanding of the taxonomic relationships among plants, beneficial organisms, and pests as the basis for research to enhance crop production and protection.

2.1.2 Collect, evaluate, preserve, and make accessible new sources of germplasm of plants and other organisms and assess their potential for meeting agricultural and industrial needs.

2.1.3 Collect, evaluate, preserve, and distribute germplasm of plants and beneficial organisms and of strains of pests that are valuable in pest-management programs.

Approach 2.2 Select and Modify Germplasm of Plants, Beneficial Organisms, and Pests.

Approach Elements

2.2.1 Devise new methods for modifying germplasm of plants, beneficial organisms, and pests.

2.2.2 Improve genetic populations of range, pasture, forage, and turf.

2.2.3 Improve genetic populations of field crops.

2.2.4 Improve genetic populations of horticultural and specialty crops.

2.2.5 Improve genetic populations of beneficial organisms, and develop inferior strains of pests that will be useful in pest-management programs.

Approach 2.3 Develop Improved Production Practices for Maintaining and Increasing Crop Productivity and Quality and for Reducing Costs.

Approach Elements

2.3.1 Develop knowledge of basic plant growth and development processes of crop species and of micro-organisms of agricultural importance.

2.3.2 Develop basic ecological principles and improved cultural and management practices for range, pasture, and forage.

2.3.3 Develop basic ecological principles and improved cultural and management practices for field crops.

2.3.4 Develop basic ecological principles and improved cultural and management practices for horticultural and specialty crops.

2.3.5 Develop basic principles for and improved methods of pollination and honey production.

2.3.6 Discover principles for and develop criteria and specifications for improving the efficiency of agricultural production and protection equipment and practices.

Approach 2.4 Discover Principles and Develop Improved Methods for Reducing Crop Losses Caused by Weeds, Diseases, Insects, Nematodes, and Other Pests.

Approach Elements

2.4.1 Develop knowledge of growth, development, and behavioral and population processes of insects as a basis for discovering control principles.

2.4.2 Develop knowledge of etiology, epidemiology, and pathogenicity of plant pathogens as a basis for discovering control principles.

2.4.3 Develop knowledge of growth, development, and behavioral processes of nematodes as a basis for providing control technology.

2.4.4 Provide technology for protecting range, pasture, forage, and turf from losses caused by insects, nematodes, pathogens, and other pests.

2.4.5 Develop principles for protecting field and horticultural crops from losses caused by insects, nematodes, and pathogens.

2.4.6 Develop knowledge of the basic biology of weeds for determining their vulnerability to control.

2.4.7 Develop control technology for reducing losses caused by weeds in forage crops, pastures, rangelands, turf, aquatic environments, and noncroplands.

2.4.8 Develop control technology for reducing losses caused by weeds in field and horticultural crops.

2.4.9 Develop fundamental principles of biological control for pests of crop plants.

2.4.10 Discover principles and develop agricultural chemical technology for reducing crop losses and for modifying plant growth for improved crop protection and production.

2.4.11 Develop fundamental principles for the control of vertebrate pests.

Approach 2.5 Develop Improved Methods for Integrating the Crop- and Pest-Management Practices Needed for Higher and More Stable Levels of Crop Production.

Approach Elements

2.5.1 Develop the means for assessing crop conditions, and identify the factors that limit yields of major crop commodities.

2.5.2 Develop growth and management models for optimum production of crop commodities.

OBJECTIVE 3 — DEVELOP THE MEANS FOR INCREASING THE PRODUCTIVITY OF ANIMALS AND THE QUALITY OF ANIMAL PRODUCTS.

Approach 3.1 — Increase the Genetic Capacity of Animals for Production.

Approach Elements

3.1.1 — Devise optimum selection and mating procedures for obtaining high levels of animal performance and improved product quality.

3.1.2 — Devise procedures for selectively manipulating genetic material to improve desired characteristics.

3.1.3 — Determine genetic variation in biochemical, physiological, and behavioral traits of animals, and devise ways for using the information to accelerate genetic improvement.

3.1.4 — Improve genetic resistance of animals to diseases and internal and external parasites.

Approach 3.2 — Improve the Efficiency of Reproduction and Reproduction-Related Biological Processes.

Approach Elements

3.2.1 — Increase the number of offspring reared per male and female maintained.

3.2.2 — Increase efficiency of germ cell and embryo production, transfer, and storage and of techniques for producing more offspring of superior quality.

3.2.3 — Increase efficiency and persistence of lactation and egg production.

Approach 3.3 — Improve Animal Nutrition and Feed Efficiency To Increase Productivity and Product Quality.

Approach Elements

3.3.1 — Remove nutrient limitations to production.

3.3.2 — Reduce losses and inefficiencies in nutrient use, and explore alternative sources of nutrients.

3.3.3 — Devise nutritional and physiological means for modifying the rate of synthesis and the composition of animal products.

Approach 3.4 Develop Ways To Prevent or Control Losses From Diseases, Parasites, and Toxicants and Other Substances That Limit Animal Performance and Reduce the Quality of Animal Products.

Approach Elements

3.4.1 Improve methods for diagnosing and identifying agents that cause losses, and improve methods for assessing those losses.

3.4.2 Establish the roles of environmental stresses and nutrition in losses from diseases and parasites.

3.4.3 Characterize the mechanisms by which animals become infected and are affected by diseases and parasites.

3.4.4 Devise new and improved methods for preventing or reducing death morbidity, and other losses from diseases and parasites.

3.4.5 Prevent, control, or eliminate losses from natural or synthetic substances to which animals may be exposed.

Approach 3.5 Develop Means for Controlling Insects, Ticks, and Mites That Affect Animals and Man.

Approach Elements

3.5.1 Improve methods of detecting infestations and assessing losses.

3.5.2 Examine mechanisms by which insects, ticks, and mites cause harmful effects.

3.5.3 Devise new and improved methods for reducing losses from insects, ticks, and mites that affect animals and man.

3.5.4 Integrate control technologies into systems approaches for managing insects, ticks, and mites that affect animals and man.

3.5.5 Develop means for protecting humans from insects and insect-borne diseases.

Approach 3.6 Devise Means for Improving and Integrating Procedures and Facilities for Production and Transport of Animals To Increase Productivity, Reduce Costs, and Minimize Stresses.

Approach Elements

3.6.1 Assess environmental impacts and shelter needs for farm animals.

3.6.2 Develop facilities and equipment for feedstuff storage, processing, and distribution.

3.6.3 Develop facilities and equipment for improving animal performance and labor efficiency in production systems.

3.6.4 Develop improved facilities and equipment for handling and transporting animals.

3.6.5 Develop systems for managing and using manure efficiently as a resource.

3.6.6 Devise integrated management practices for maximizing animal productivity and product quality, while minimizing stress.

3.6.7 Evaluate, for optimum use of resources, management programs that integrate all productivity elements under various environmental conditions.

OBJECTIVE 4 DEVELOP THE MEANS FOR ACHIEVING MAXIMUM USE OF AGRICULTURAL PRODUCTS FOR DOMESTIC MARKETS AND EXPORT.

Approach 4.1 Develop Means for Enhancing the Inherent Properties and Uses of Agricultural Materials.

Approach Elements

4.1.1 Characterize the basic, physical, chemical, and aesthetic properties of plant and animal materials that enhance their usefulness.

4.1.2 Identify the biological and biochemical mechanisms, in plants and animals, that affect properties of agricultural materials.

4.1.3 Devise means for regulating and controlling the biological processes that enhance usefulness.

4.1.4 Devise concepts for innovative and improved processes and products.

Approach 4.2		Develop the Means for Meeting Foreign and Domestic User and Regulatory Requirements Relating to Toxic Factors in Food, Feed, and Other Agricultural Products.
Approach Elements		
	4.2.1	Identify and, when necessary, develop the means for removing intrinsic toxic factors of practical significance.
	4.2.2	Identify and, when necessary, develop the means for removing extrinsic toxic factors of practical significance.
Approach 4.3		Develop Means for Reducing or Eliminating Postharvest Losses Caused by Pests, Spoilage, and Physical and Environmental Damage.
Approach Elements		
	4.3.1	Develop improved methods for controlling losses caused by insect pests.
	4.3.2	Develop improved methods for controlling losses caused by micro-organisms.
	4.3.3	Develop improved methods for controlling losses caused by internal chemical and biological mechanisms.
	4.3.4	Develop improved methods for controlling losses caused by physical forces.
Approach 4.4		Develop the Means for Increasing Efficiency of Systems for Processing, Handling, Storing, and Distributing Agricultural Products.
Approach Elements		
	4.4.1	Identify system inefficiencies.
	4.4.2	Devise means for reducing or eliminating inefficiencies.
	4.4.3	Devise means for efficiently classifying products for exchange in the marketplace.
	4.4.4	Devise means for meeting domestic and foreign quarantine and other requirements that restrict movement and trade of products.

OBJECTIVE 5 DEVELOP THE MEANS FOR PROMOTING OPTIMUM HUMAN HEALTH AND WELL-BEING THROUGH IMPROVED NUTRITION AND FAMILY RESOURCE MANAGEMENT.

Approach 5.1 Define the Nutrient Requirements of Humans at all Stages of the Life Cycle.

Approach Elements

5.1.1 Establish the nutrient requirements of infants, children, and adolescents.

5.1.2 Establish the nutrient requirements of pregnant and lactating women.

5.1.3 Establish the nutrient requirements of adult humans.

5.1.4 Establish the relationship between nutrition and aging.

Approach 5.2 Determine the Nutrient Content of Agricultural Commodities and Processed Foods as Eaten, and Establish the Bioavailability of Their Nutrients.

Approach Elements

5.2.1 Compile essential data on the nutrient contents of foods as consumed in the United States.

5.2.2 Determine bioavailability of nutrients in foods as consumed.

Approach 5.3 Improve the Nutritional Status of Humans and the Well-Being of Families by Making Techniques Available for Assessing the Effectiveness of Nutrition and Home Economics Programs.

Approach Elements

5.3.1 Provide means for improving understanding of dietary practices, food-consumption patterns, and their determinants through assessments.

5.3.2 Develop reliable, efficient, and inexpensive methods for defining nutritional status and evaluating nutrition action programs.

5.3.3 Develop methods for improving family economic stability and security.

OBJECTIVE 6 — DEVELOP THE MEANS FOR INTEGRATING SCIENTIFIC KNOWLEDGE OF AGRICULTURAL PRODUCTION, PROCESSING, AND MARKETING INTO SYSTEMS THAT OPTIMIZE RESOURCE MANAGEMENT AND FACILITATE TRANSFER OF TECHNOLOGY TO USERS.

Approach 6.1 — Develop Integrated Systems for Efficiently Producing, Processing, and Marketing Agricultural Products.

Approach Elements

6.1.1 — Assess and quantify the critical interactions among the different factors needed for producing and marketing food and agricultural products.

6.1.2 — Develop predictive models for simulating the effects of key physical and biological factors on agricultural productivity and environmental quality.

6.1.3 — Establish and operate multivariate experiments on integrated agricultural systems to validate models, facilitate technology transfer, and serve as a base for agricultural productivity forecasts.

6.1.4 — Develop technology for using remotely sensed data to assess and maintain the conditions of our natural resources and to provide information for resource models.

Approach 6.2 — Develop Alternative Agricultural Systems, Including Those of Small Scale, That are Less Dependent Upon Nonrenewable Resources and That Are Productive, Efficient, and Sustainable in the Long Term.

Approach Elements

6.2.1 — Develop the means for small-scale commercial farmers and other small-scale producers to maximize efficiency and productivity.

6.2.2 — Develop productive biological/organic agricultural systems that avoid or minimize the use of nonrenewable inputs, conserve soil and water resources, maintain or increase soil productivity, and produce high-quality products.

6.2.3 — Develop the knowledge needed for increasing the productivity of tropical/subtropical agricultural systems.

6.2.4 — Develop systems and technology for reducing the dependence of agriculture on fossil fuels.

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